Development And Demonstration Of PEM Fuel Cell Educational Program For School And University Communities

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OBJECTIVES

- Participate in the Mission of the Department of Energy's Hydrogen, Fuel Cells & Infrastructure Program in the following areas:
  - Development of an understanding of the general concept and value of a hydrogen economy.
  - Realize the near term realities and opportunities of hydrogen and fuel cell technologies.
  - Develop an accurate picture of hydrogen safety issues.
  - Help the public understand their part in facilitating the transition to a hydrogen economy.

OBJECTIVES (CONTINUED)

- Development and assessment of PEM fuel cells educational units for use in middle schools, junior high schools.
- Implementation of energy related courses in campus curricula, middle school teacher education.
- Support campus Chapter of the Society for Energy Alternatives and their efforts to develop a PEM fuel cell powered vehicle for demonstrations, racing, and outreach with schools, the community, and governmental leaders.

SUMMARY OF MAJOR TASKS

- Tasks:
  - 1. Development and implementation of educational modules and web-based teaching resources
  - 2. Teacher training of middle school and junior high school teachers
  - 3. Outreach and educational activities with the public
  - 4. Assessment

MILESTONES FOR EACH TASK

- Task 1: Development and implementation of educational curriculum
  - 1.1: Computer-based interactive animation of PEM fuel cell.
    - Target date: Sept 2004
    - Status: _ complete
  - 1.2: Computer-based animation of system integration of PEM fuel cell and performance.
    - Target date: Sept, 2004
    - Status: _ complete
  - 1.3: Purchase small-scale fuel cell and electrolyzer units (for evaluation).
    - Target date: Dec, 2003
    - Status: Complete
  - 1.4: Develop & deliver a university-level course
    - Target date: Dec, 2003
    - Status: Complete
  - 1.5: Develop a 1 week instructional unit for grades 6-8 teachers to use.
    - Target date: June 2004
    - Status: _ complete. Follows Industrial Technology Education Association's Standards for Technology Literacy

MILESTONES FOR EACH TASK

- Task 2: Teacher Training
  - 2.1: One-week summer workshop for up to 20 grade 6-8 teachers to educate and train in PEM fuel cell curriculum unit.
    - Target Date: July 2004
    - Status: Has been scheduled. Advertisements have been sent. Selecting participants.

MILESTONES FOR EACH TASK

- Task 3: PEM FC Racing Car Outreach and Educational Activities with the Public
  - 3.1: Fuel cell car – design work
    - Target date: April, 2004
    - Status: Behind schedule. PEM fuel cell expected to be delivered in late May, 2004. Performance data will be collected following its delivery.
    - Options: Contacting other PEM FC manufacturers for sponsorship or purchase as a contingency plan. Proving to be cost-prohibitive.
  - 3.2: PEM FC car fabrication
    - Target date: May, 2004
    - Status: Delayed due to 3.1
  - 3.3: PEM FC car testing
    - Target date: May, 2004
    - Status: Delayed due to 3.1
  - 3.4 & 3.5: PEM FC car outreach events (racing)
    - Target dates: Aug, 2004
    - Status: Delayed due to 3.1

MILESTONES FOR EACH TASK

- Task 3: PEM FC Racing Car Outreach and Educational Activities with the Public
  - 3.6: PEM FC car redesign
    - Target date: May, 2005
    - Status: Possibly behind schedule
  - 3.7 & 3.8: PEM FC car outreach events (racing)
    - Target dates: May and Aug, 2005
    - Status: On track
  - 3.9 & 3.10: PEM FC car media events and demonstrations
    - Target dates: Sept, 2005
    - Status: On track
  - 3.11: PEM FC car website
    - Target date: Dec, 2003
    - Status: _ complete due to delays in 3.1. Some content has been posted.

MILESTONES FOR EACH TASK

- Task 4: Assessment
  - 4.1: Assessment survey development
    - Target: Dec, 2003
    - Status: Completed. Tested on our university students.
  - 4.2: Assessment Survey-Market Place for Kids.
    - Target: April, 2004
    - Status: Completed.
  - 4.3: Assessment Survey Market Place of Ideas & Market Place for Kids
    - Target: Jan & April, 2005
    - Status: Not done at this time. On track.
  - 4.4: Preliminary Assessment Report
    - Target: April 2004
    - Status: Complete. (Not able to include in this report due to early submission date)
  - 4.5: Assessment Report (will also include survey results grades 6-8 using our instructional unit)
    - Target: Sept 2004 & Sept 2005
    - Status: In progress.

CRITICAL ATTENTION AREAS

- All major targets are on track with the exception of the PEM fuel cell car.
  - Corporate partner is in the process of improving their technologies.
  - As a contingency plan, we are looking at two options:
    - A possible alternative corporate partner or supplier willing to donate a 10KW PEM fuel cell stack.
    - Also considering outright purchase of a PEM fuel cell stack, which is proving to be cost prohibitive at approximately $100,000.

BUDGET

CATEGORIES	TOTALS BY CATEGORY	FY04		FY05	
		DOE	UND	DOE	UND
Salaries & Wages	104,048	34,462	17,562	34,462	17,562
Teacher Training Stipends	8,000	4,000		4,000	
Travel	16,500		6,500		10,000
Communications	500		250		250
Data Processing	2,000		2,000		
Office	3,000		3,000		
Supplies	12,000		12,000		
Major Equipment	19,000		19,000		
Corporate Partner Contribution (PEM Fuel Cell Stack)	60,000		60,000		
Indirect Costs	23,076	11,538		11,538	
Total	248,124	50,000	120,312	50,000	27,812

NOTE: The UND Society for Energy Alternatives (a non-profit entity) also conducts fundraising for the PEM Fuel Cell Car and also engages in hundreds and hundreds of hours dedicated to the design, fabrication, testing & racing of the PEM Fuel Cell Car and

TECHNICAL BARRIERS AND TARGETS

- Instructional PEM FC units and equipment suitable for classroom use have been identified.
- PEM Fuel Cell Car design has numerous outstanding technological issues which need to be resolved:
  - Safety assurance of system design
  - Gas flow rates & pressure control (sensors & pumps & controller programming)
  - Control of humidity within the fuel cell's membrane
  - Temperature control
  - Traction motor and controller interface to the PEM fuel cell system (load balancing)
- We are working with vendors and design engineers to resolve these issues.

PROJECT PARTICIPANTS

- Principal Investigator
  - Scott Tolbert, Assistant Professor
    Department of Mechanical Engineering, Univ. of North Dakota
- Co-Principal Investigators
  - Dr. C. Ray Diez, Professor
    Department of Industrial Technology, Univ. of North Dakota
  - Dr. Hossein Salhefar, Professor
    Department of Electrical Engineering, Univ. of North Dakota
  - Dr. Michael Mann, Professor
    Department of Chemical Engineering, Univ. of North Dakota
- Graduate Students
  - Andrew Peters
    Department of Electrical Engineering, Univ. of North Dakota
  - Amy Boll
    Department of Industrial Technology, Univ. of North Dakota
- Undergrad Students
  - UND Chapter of the Society for Energy Alternatives
- Corporate Partner has requested to remain anonymous pending announcement of their technology.